Course guide
240207 - 240EN12 - Energy Engineering Project

Last modified: 25/05/2023

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 724 - MMT - Department of Heat Engines.

Degree: MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2022). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: Velo Garcia, Enrique

Others: Velo Garcia, Enrique
Mas De Les Valls Ortiz, Elisabet
Bordonau Farrerons, Josep
Prieto Araujo, Eduardo

PRIOR SKILLS

Knowledge and skills in engineering project management at bachelor level.

REQUIREMENTS

none

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEEN6. (ENG) Aplicar criteris tècnics i econòmics en la selecció de l'equip elèctric més adequat per a una determinada apliació. Dimensionar equips e instal.lacions elèctriques. Reconeixer i valorar les aplicacions tecnològiques més novedoses en l'àmbit de la producció, transport, distribució, emmagatzematge i us de l'energia elèctrica.
CEEN7. (ENG) Analitzar el comportament d'equips i instal.lacions en operació a fi d'elaborar un diagnòstic valoratiu sobre el seu règim d'explotació i d'establir mitjans dirigits a millorar la seva eficiència energètica.
CEEN8. (ENG) Entendre, descriure i analitzar de forma clara i amplia el funcionament dels mercats energètics i portar a terme la contractació de subministres energètics de forma optimitzada.
CEEN9. (ENG) Dur a terme projectes relacionats amb la gestió de l'energia en diferents sectors productius i de serveis, reconeixent i valors els avenços i novetats en aquest camp i aportant idees novedosas.
CEEN5. (ENG) Aplicar criteris tècnics i econòmics en la selecció de l'equip tèrmic més adequat per a una determinada aplicació. Dimensionar equips e instalacions térmiques. Reconeixer i valorar les apliacions tecnològiques més novedoses en l'àmbit de la producció, transport, distribució, emmagatzematge i us de l'energia.
CEEN1. (ENG) Entendre, descriure i analitzar, de forma clara i àmplia tota la cadena de conversió energètica, des del seu estat com "font d'energia" fins el seu us com "servei energètic". Identificar, descriure i analitzar la situació i característiques dels diferents recursos energètics i dels usos finals de l'energia, en les seves dimensions econòmica, social i ambiental; i formular judicis valoratius.
CEEN3. (ENG) Avaluar l'impacte econòmic, social i ambiental de la producció, us i gestió de l'energia, amb una visió holística del cicle de vida dels diferents sistemes. Reconèixer i valorar les novetats més destacables en els àmbits de l'eficiència energètica i de l'us racional de l'energia.
CEEN4. (ENG) Realitzar de manera eficient l'obtenció de dades de recursos renovables d'energia i el seu tractament estadístic, així com aplicar coneixements i criteris de valoración en el diseny i avaluació de solucions tecnològiques per a l'aprofitament de recursos renovables d'energia, tant per a sistemes aïllats com connectats a xarxa. Reconéixer i valorar les aplicacions tecnològiques més novedoses dels recursos renovables d'energia.

Generical:
CGEN01. (ENG) Integrar i aplicar els coneixements matemàtics, analítics, científics, instrumentals, tecnològics i de gestió adquirits en la formació universitàtia, així com la seva capacitat de resolució de problemes, dintro de l'àmbit de la ingenieria de la energia.
CGEN02. (ENG) Dimensionar, analitzar, disenyar i projectar equips, instal.lacions, infraestructures i processos de transformació i transport de la energia en qualssevol de les fases o etapes de la cadena energètica, des de les fonts fins l'us final de l'energia i intervenir en procesos de planificació, redacció, direcció i gestió de projectes en l'àmbit de la ingenieria de l'energia.
CGEN03. (ENG) Intervenir en procesos d'investigació, desenvolupament i innovació en l'àmbit de les tecnologies energètiques i de l'us de l'energia en els sectors productius i de serveis, aportant nous coneixement, avenços tecnològics i solucions innovadores en equips de treball multidisciplinars, nacionals o internacionals.
CGEN04. (ENG) Analitzar de forma crítica les polítiques energètiques regionals, nacionals i supranacionales i saber aplicar la legislació en matèria energètica en qualssevol dels àmbits de la ingenieria de l'energia i de la gestió energètica.
CGEN07. (ENG) Analitzar l'impacte econòmic, social i ambiental de les solucions tècniques tant en l'explotació de les fonts primàries d'energia, com en la transformació, transport i us final de l'energia.
CGEN06. (ENG) Dur a terme dictàmens i assessorament tècnic en l'àmbit de la ingeniera de l'energia.

Transversal:
CT1. (ENG) EMPRENEDORIA I INNOVACIÓ: Conèixer i comprendre l'organització d'una empresa i les ciències que regeixen la seva activitat; tenir capacitat per comprendre les normes laborals i les relacions entre la planificació, les estatègies industrials i comercials, la qualitat i el benefici.
CT2. (ENG) SOSTENIBILITAT I COMPROMÍS SOCIAL: Conèixer i comprendre la complexitat dels fenòmens econòmics i socials típics de la socitat del benestar; tenir capacitat per relacionar el benestar amb la globalització i la sostenibilitat; aconseguir habilitats per usar de forma equilibrada i compatible la tècnica, la tecnologia, l'economia i la sostenibilitat.
CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

CT4. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

Basic:
CB 6. (ENG) Tenir i comprendre coneixements que aportin una base o oportunitat de ser originals en el desenvolupament i/o aplicació d'idees, sovint en un context d'investigació
CB 7. (ENG) Que els estudiants sàpiguen aplicar els coneixements adquirits i la seva capacitat de resolució de problemes en entorns nous o poc coneguts dintre de contextos més amplis (o multidisciplinars) relacionats amb la seva àrea d'estudi.
CB10. (ENG) Que els estudiants poseeixin les habilitats d'aprenentatge qur els permetin continuar estudiant d'una manera d'una forma que haurà de ser en gran mesura autodirigit o autonònom
CB 8. (ENG) Que els estudiants siguin capaços de d'integrar coneixements i enfrentar-se a la complexitat de formular judicis a partir d'una informació que, essent incompleta o limitada, inclogui reflexions sobre les responsabilitats socials i ètiques vinculades a l'aplicació del seus conexicements i judicis.
CB 9. (ENG) Que els estudiants sàpiguen comunicar les seves conclusions i coneixements (i darrers raonaments que els sostentin), a públics especialitzats i no especialitzats de manera clara i sense ambigüitats.

TEACHING METHODOLOGY

During the course, students work in small groups. The learning process is based on carrying out a complex or extensive project related to the energy engineering sector. During the realization of the project, the students apply and expand their knowledge and write a report where the motivation, the objectives, the design, the planning, the results and the conclusions are exposed.

The face-to-face classes will be mainly participatory. They may include:

- Activities such as debates, group dynamics, role-playing games with the teacher and other students in the classroom.
- Carrying out in the classroom an activity or exercise of a theoretical or practical nature, individually or in small groups, with the advice of the teacher.
- Monitoring the project with the tutor.
- Work with the members of the project group in its development.
- The presentation in the classroom of an activity carried out individually or in small groups.

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course, the student

Understands the role of energy sources and energy equipment in the productive and service sectors, as well as their importance in the energy chain: transformation, transportation, distribution, and the final and efficient use of energy.

Has the knowledge, skills and elements of analysis necessary to select the most appropriate sources and equipment, from the energy point of view for each application (industrial or services), as well as the ability to analyze the behavior of a team in operation, carry out a diagnosis of its exploitation regime and establish measures aimed at improving its energy.

Has the knowledge, skills and elements of analysis necessary to propose a project, on a basic or functional engineering scale, related to the conception, dimensioning and/or use of thermal and electrical equipment in different industrial and service sectors.

It is capable of proposing transferable results -in the improvement of thermal and electrical equipment and energy services- through the elaboration of novel ideas.

STUDY LOAD

Type	Hours	Percentage
Hours large group	15,0	33.33
Hours small group	30,0	66.67

Total learning time: 45 h

CONTENTS

Energy Engineering Project - Course Contents

Description:
- The project and its phases.
- Phases of a research and development project.
- Problem definition and needs analysis
- Technical design and analysis of alternatives
- Economic viability. Business models. Actor analysis. Financing mechanisms.
- Environmental and social impact.
- Communication mechanisms.

Related activities:
Energy Engineering Project - Group work.

Full-or-part-time: 125h
Practical classes: 30h
Guided activities: 15h
Self study : 80h

ACTIVITIES

Energy Engineering Project - Group work. Group 11. Renewable Energy, Thermal Energy and Energy Management

Description:
Prof. Elisabet Mas de les Valls & Prof. Enrique Velo

The energy project will be chosen by each team and the problem to be solved will necessarily have a multidisciplinary nature, and use renewable energy sources.

After getting the consensus of the teaching team, the project development will start following a role-play. The goal is to follow the standard participatory process of a public call within 3 stages. In the first stage, each team will prepare and write the proposal, to be then presented in a public call. In the second stage, each team will receive one of their mates' proposal and allegations will be prepared and presented to the Administration (the teaching staff). Special emphasis will be placed on the environmental and social impact of the proposal. The Administration will then prepare the corresponding resolution of the allegations. In the third and last stage, each team will apply the required modifications to their project and, then, the final project will be presented.

The energy project will be carried out in large teams (8-10 persons) to be able to prepare a holistic proposal, taking special relevance team management, roles and continuous work.

Specific objectives:
1. Extend the students background in the design of energy solutions (for electricity, heating/cooling and DHW) based on renewable energy sources.
2. Provide guidelines on how to proceed on a standard participatory process of a public call.
3. Raise awareness on the different points of view and interests of the diverse stakeholders within an energy project, from the administration to the general public.
4. Offer the opportunity of being a team leader (by rotatory roles) and identify the strengths and weaknesses of each individual and the team.

Full-or-part-time: 125h
Practical classes: 30h
Guided activities: 15h
Self study: 80h

Energy Engineering Project - Group work. Group 12. Electrical engineering and MSc. SENSE

Description:
Main course instructor: Prof. Eduardo Prieto

The key objective of this group is to teach students the basic principles of project development in the context of electrical and energy engineering. They will learn how to apply criteria for the selection of options, decision making, assessment, and organization while completing the project. The projects will be organized in groups of several students working to foster teamwork.
The project topic selection will be discussed and agreed at the start of the course, including renewable energy topics (PV, onshore and offshore wind, solar), microgrids, HVDC, hydrogen installations, etc.). The topic can be adjusted to the particular motivations and interests of the group.

The project will be developed along the semester, including three presentations: project conceptual proposal, mid-term proposal and final presentation. At the end of the course, the full project report should be delivered. During the presentations the groups will receive feedback both from students and the teacher, in order to improve the quality of the project.
Potential project topics are listed below (but not limited to):

• Solar Power Plant Connection Project
• Wind Power Plant Connection Project (onshore/offshore)
• Electrical Substation Project
• Overhead Line Project
• HVDC Project
• Microgrid Project
• Smart Grid Project
- Hydrogen Electrolyzers

Specific objectives:
- Learn the fundamental stages of an electrical/energy engineering process
- Learn the basic teamwork organizational techniques
- Perform autonomous work towards completing the project goals
- Practice communication skills during the project expositions
- Improve the report preparation quality

Delivery:
Two deliverables are expected: the mid-term Project Draft and the Final Project submission.

Full-or-part-time: 125h
Practical classes: 30h
Guided activities: 15h
Self study: 80h

Energy Engineering Project - Group work. Group 13. MSc. RENE

Description:
Prof. Josep Bordonau.

This group will work the particular methodology developed by prof. Bordonau based in "An Industrial Feasibility Analysis", a method that has been developed by EIT InnoEnergy and includes all the elements mentioned in the course description. Teams of 4-6 members will work a subset of the Analysis, customized to the specific Challenge proposed by the company.

In addition:
- Professional communication skills oriented to project management.
- Decision making methods.

The company describes the Challenge in a kick-off presentation with a Q&A session with the students and the teacher. From this point, the Challenge starts and it is managed in, at least, a weekly contact of the students and the teacher (preferably in presence) and a weekly contact with the company (in presence, online or email; depends on the availability of the industry experts). The industry experts co-create with the teacher the milestones of the project, when the key decisions must be taken. A "Gate meeting" is organized where the students present their findings and decisions for every Milestone, with the participation of the industry experts. 4-5 Gate meetings are planned along the semester. The students prepare a presentation, a document and/or a tool for every Gate Meeting. The final Gate Meeting is the presentation of the Final Report document, clearing all questions from the industry experts.

Specific objectives:
- Delivering a technical solution to the Challenge.
- Understanding and doing a professional Feasibility Analysis.
- Understanding and doing a professional Communication (internal and external).
- Understanding and doing a professional Decision-making.

The students are self-organized in teams, with the supervision of the teacher. Practice of "Team Building".
The students discover along the Challenge all the different topics listed in the "Description". On top of that, the feedback given by the industry experts is proven to be very stimulating.

Full-or-part-time: 125h
Practical classes: 30h
Guided activities: 15h
Self study: 80h

GRADING SYSTEM

Work done throughout the course: 70%

It includes both the evaluation of results and reports, as well as their oral presentation. The teacher of each group of projects can include mechanisms and adhoc parameters for the evaluation of the quality of the work carried out. The rating can be different and customized for each member of a project group.

Active participation in classes: 10%

It is an individual qualification that includes the evaluation of the active participation in the activities carried out in the classroom and the active participation in the follow-up meetings to monitor the project. The latter can include the degree of achievement of the objectives of each follow-up meeting, evaluating the active participation of each student or group of students in the tasks to be carried out during the periods between two meetings.

Performance and quality of group work: 20%

It is an individual qualification that includes peer evaluation, the quality of the minutes of the group meetings and any other element of evaluation that the tutor of the project group deems appropriate to assess the performance and quality of group work.

Generally applicable rules:

There will be no test of a global nature that replaces the continuous evaluation.

The teacher of each group of projects, through follow-up meetings and feedback on the partial documents delivered, will correct the unsatisfactory results obtained during the course.

All students who have not passed the subject can be submitted for re-evaluation. The act of re-evaluation will be defined by the teacher of the project group and will be aimed at reassessing those aspects in which the student has shown not to achieve the learning objectives of the subject.